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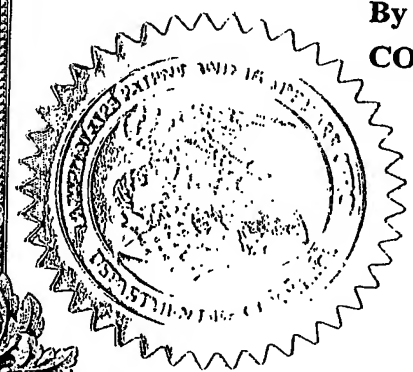

W. MONTGOMERY
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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

INVENTOR(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
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☐ Additional inventors are being named on the ____ separately numbered sheets attached hereto

TITLE OF THE INVENTION (280 characters max)

A METHOD AND APPARATUS FOR EXPLICITLY DESCRIBING DECODING AND PRESENTATION TIMES IN A GRAPHICS DECODER MODEL INCORPORATING AN IMAGE BUFFER AND GRAPHICS PLANE BUFFER

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ENCLOSED APPLICATION PARTS (check all that apply)

☒ Specification *Number of Pages* 30
☐ CD(s), Number
☐ Drawing(s) *Number of Sheets*
☐ Application Data Sheet. See 37 CFR 1.76
☐ Other (specify)

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT (check one)

☐ A check or money order is enclosed to cover the filing fees EV336024571US
☒ The Director is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number 19-2814
☐ Payment by credit card. Form PTO-2038 is attached.

FILING FEE AMOUNT ($) $160.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.
☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

Respectfully submitted,

SIGNATURE

Date 07.03.2003

TYPED or PRINTED NAME Joseph W. Price

REGISTRATION NO. (if appropriate) 25,124

TELEPHONE 949-253-4920

Docket Number: 17366.1350

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop Provisional Application, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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A METHOD AND APPARATUS FOR EXPLICITLY DESCRIBING DECODING AND PRESENTATION TIMES IN A GRAPHICS DECODER MODEL INCORPORATING AN IMAGE BUFFER AND GRAPHICS PLANE BUFFER

BACKGROUND OF THE INVENTION

Field of the Invention

The use of shorter wavelengths in the blue wavelength range have enabled the development of storage medium that can store greater amounts of data and more particularly has created software protocols for defining conceptual decoder models and the syntax and semantics of a data stream.

Related Art

The ETSI EN 300 743 standard defines a conceptual decoder model and the syntax and semantics of a data stream to support Subtitling applications as part of the Digital Video Broadcast standard (DVB-SUB). This standard specifies the use of PES packets within an MPEG transport stream to carry the basis syntactic elements (Segments) of the Subtitling application. The PTS values of the PES packets are used to define the presentation time of each display update. No other timing information is provided to the decoder.

SUMMARY OF THE INVENTION

As part of the development of a BD-ROM format, the Blu-ray Disc Founders (BDF) are defining the syntax and semantics of data-streams and associated decoding models for presentation graphics (subtitles and other AV synchronized graphics) and interactive graphics (buttons – similar to the highlight functionality of DVD-Video). A DVD-SUB standard is being used as a base in these sections of the BD-ROM format.

This innovation, when applied to BD-ROM presentation and interactive graphics streams, provides advantages over the standard DVB-SUB model for decoder implementation and verification:

1. decoder implementation: the decoder design is greatly simplified due to the ability to perfect decoding burden based on DTS and PTS values.

2. verification: with the use of DTS/PTS in the graphics stream, it is simpler to verify that the graphics stream does not exceed the limitations of the conceptual decoder model.

This innovation extends the DVB-SUB model to make use of DTS values to specify when the decoder should decode segment data stored in the Coded Data Buffer. Furthermore, this innovation specifies use of PTS values to define when data should either be transferred between buffers or ready in buffers for a Decoder Model that includes a Graphics Plane.

The apparatus is comprised of the following:

1. The definition of DTS/PTS semantics for each Segment.

2. A decoding model supporting the use of DTS/PTS as specified.

Please refer to the attached document for a more detailed description of the innovation and some examples, based on this innovation, of DTS/PTS values that would be applied to the Graphics stream.

BD-ROM

SUBTITLE/AV SYNCHRONISED GRAPHICS AND NAVIGATION GRAPHICS

Decoder Model Issues

Decoder Data Overview: Segments

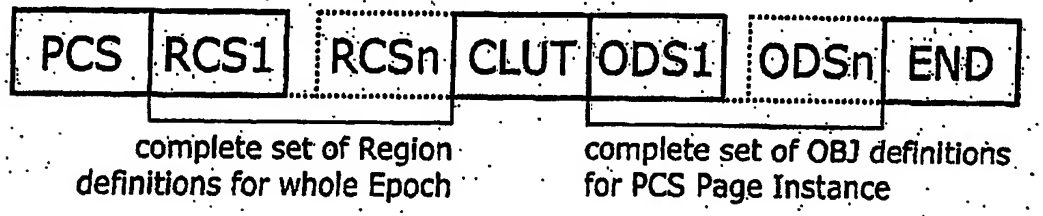
- ***"Segments"*** **are the basic building blocks of Graphics Stream.**
- **Each *Segment* is a data structure in the Graphics Stream.**
- **Each *Segment* is carried in a PES packet which in turn is carried in an MPEG2 transport stream.**
- **The following are valid *Segments*:**
  - **Subtitles/AV-Sync Graphics:**
    1. extended Page Composition Segment (PCS)
    2. extended Region Composition Segment (RCS)
    3. CLUT Definition Segment (CLUT)
    4. Object Data Segment (ODS)
    5. End of display set Segment (END)
  - **Navigation Graphics:**
    1. Menu Page Composition Segment (MCS)
    2. extended Region Composition Segment (RCS)
    3. CLUT Definition Segment (CLUT)
    4. Object Data Segment (ODS)
    5. End of display set (END)

Decoder Data Overview: Display Sets (1/3)

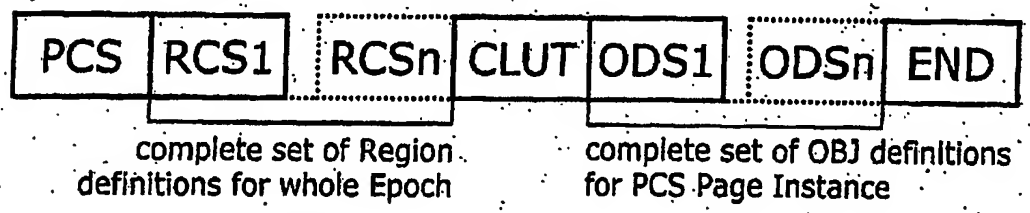
- **Segments are grouped together into *"Display Sets"*:**
  - Each Segment begins with a PCS and ends with an END.
    - Note: In DVB, a normal Display Set is not required to contain a PCS, but a PCS is always inferred – section 5.1.1 of DVB-SUB.
  - A Display Set is the set of segments required to decode a new Page Instance. **Each Display Set results in a new Page Instance.**
- **Three types of Segment in both Subtitle/AV-Sync and Navigation Graphics:**
  1. **Mode change** – start of Epoch and Random Access Point (TBD).
  2. **Acquisition Point** – Random Access Point (TBD).
  3. **Normal** – cannot be used for Random Access, only provides updates to previous Display Set.

Decoder Data Overview: Display Sets (2/3)

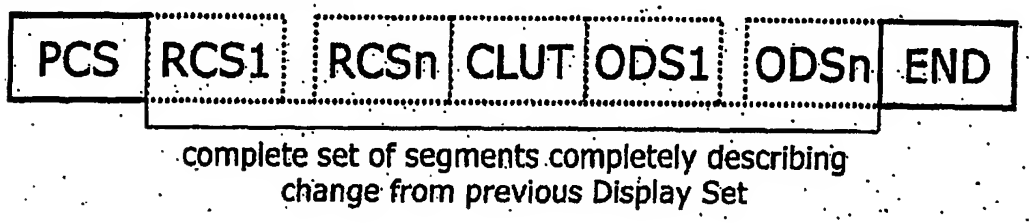
- **Subtitles/AV-Sync Graphics Display Sets:**
  1. **"Mode change"** Display Set:



  2. **"Acquisition point"** Display Set:



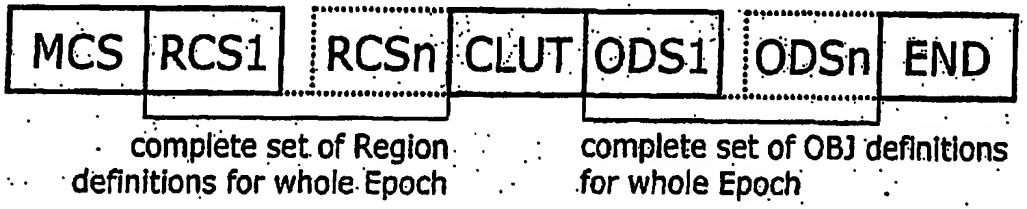
  3. **"Normal"** Display Set:



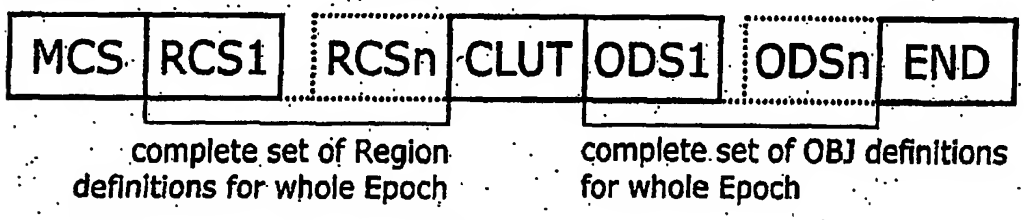
NOTE: Examples above show the DVB model, **this may be changed** with the Samsung/Thomson Decoder Model (discussed later).

Decoder Data Overview: Display Sets (3/3)

- **There are Three types of Display Set for Navigation:**
  1. **"Mode change"** Display Set:



  2. **"Acquisition point"** Display Set:



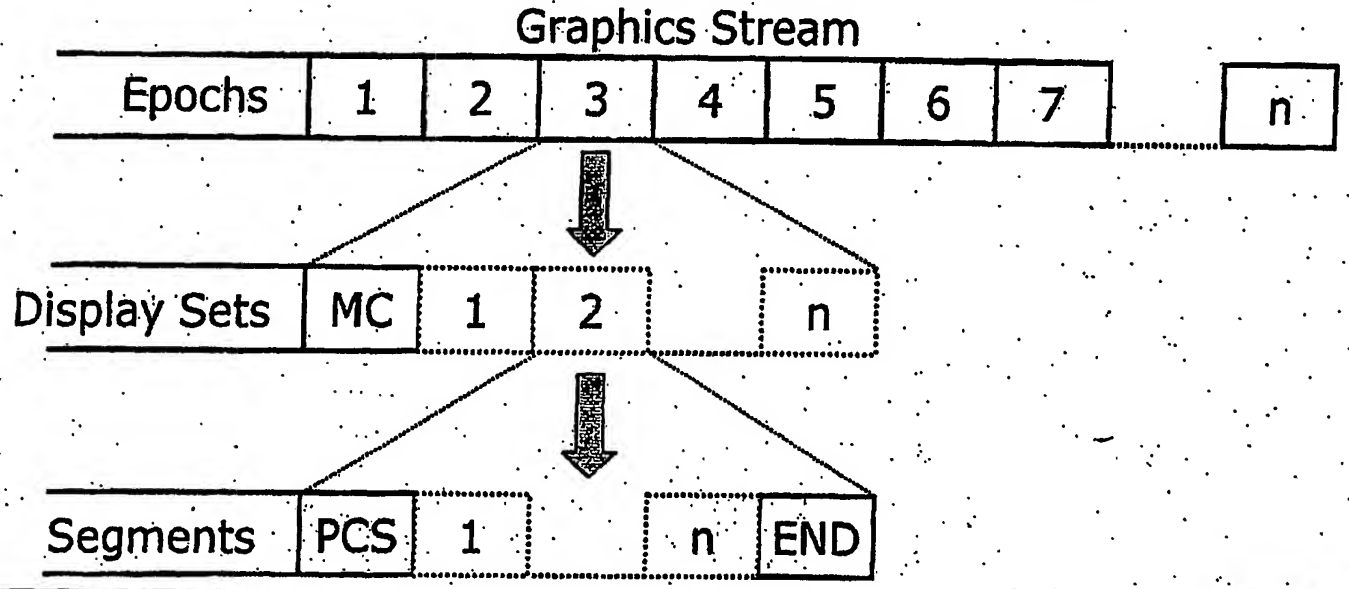
  3. **"Normal"** Display Set (TBD*):

***CLUT updates may be permitted for fade-in/out – TBD.**

NOTE: Examples above show the DVB model, **this may be changed** with the Samsung/Thomson Decoder Model (discussed later).

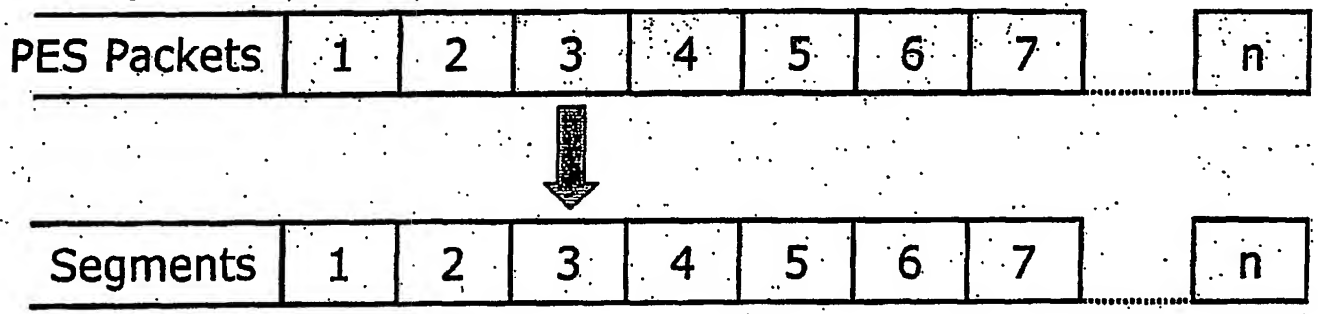
Decoder Data Overview: Epoch

- An Epoch contains one or more Display Sets.
- An Epoch always begins with a "mode change" Display Set
  - Represented as *"MC"* in Display Sets below.
- The body of an Epoch contains zero or more "acquisition point" or "normal" Display Sets.
  - (1)→(n) in Display Sets below.
- There is no structure indicating the end of an Epoch.

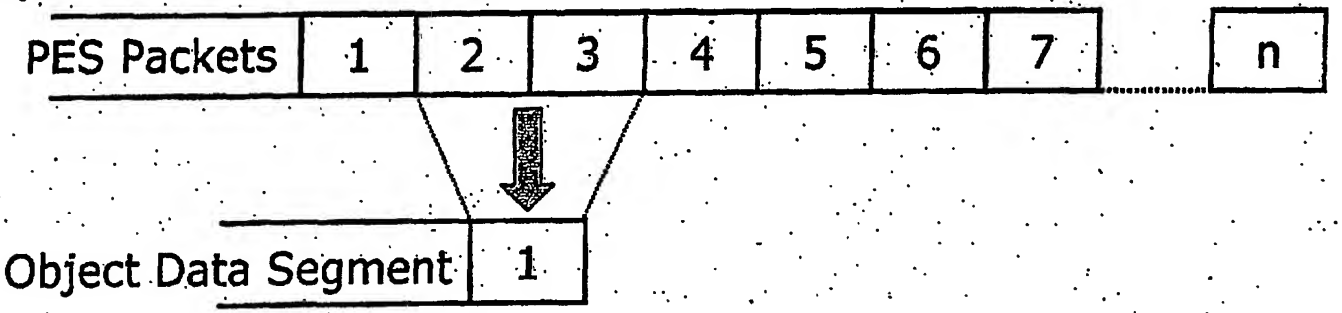


Decoder Data Overview: PES Packets (1/2)

- A PES packet carries at most one Segment.



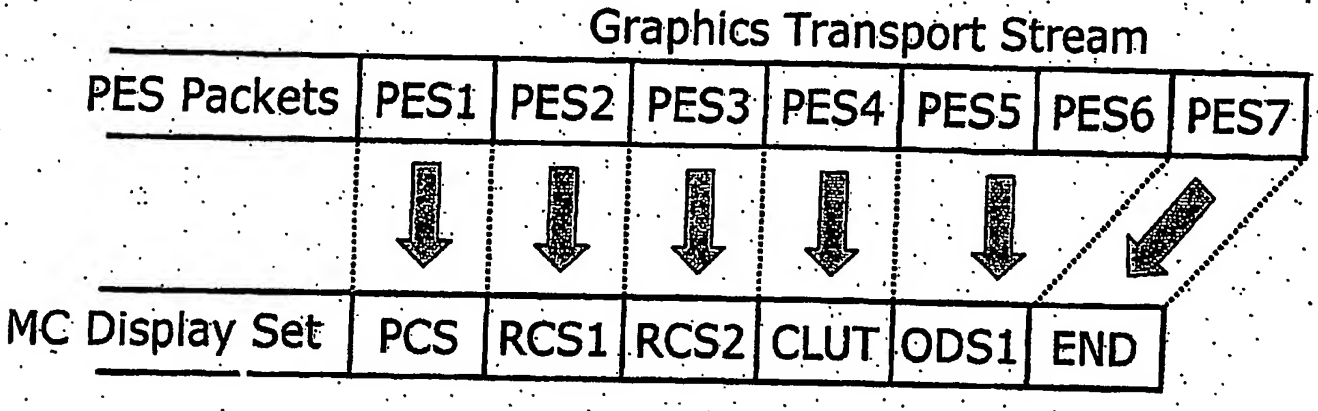
- The Object Data Segment may exceed 64kB and so may be split over multiple, sequential PES packets.



- All other Segments are contained completely within a PES packet.

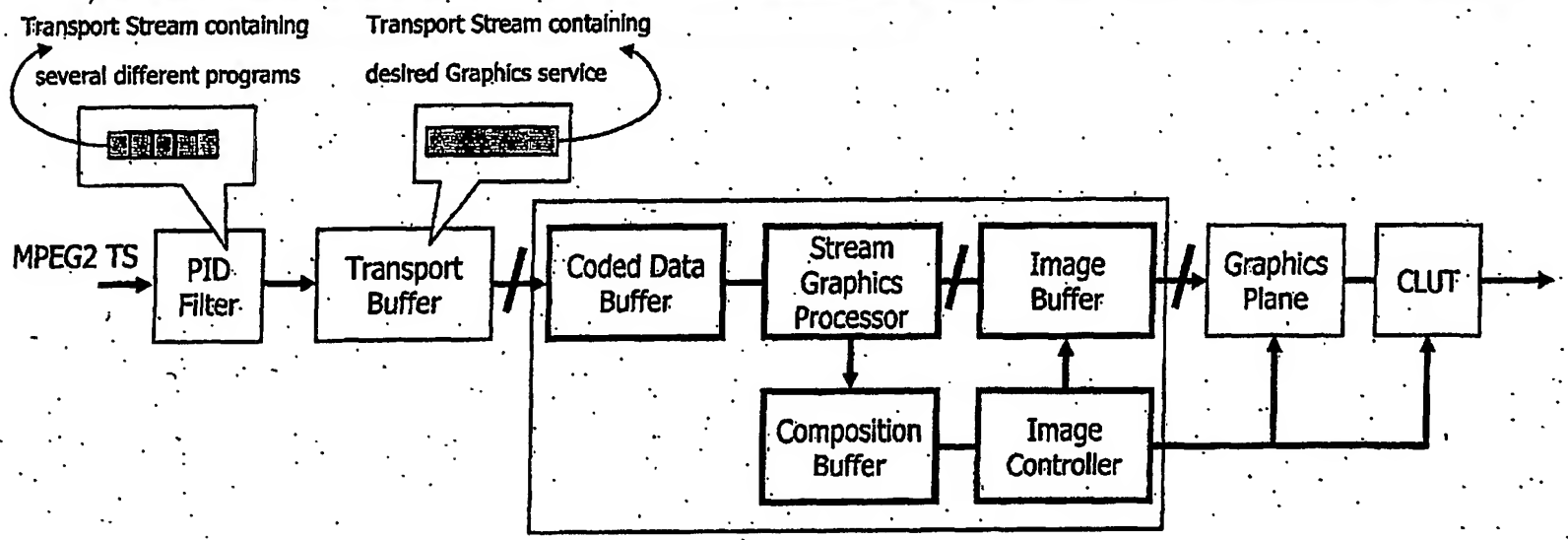
Decoder Data Overview: PES Packets (2/2)

- PES Packets are carried in an MPEG2 Transport Stream.
- The example below shows the transport of a Mode change Display Set in a Subtitle/AV-Sync Graphics Stream:



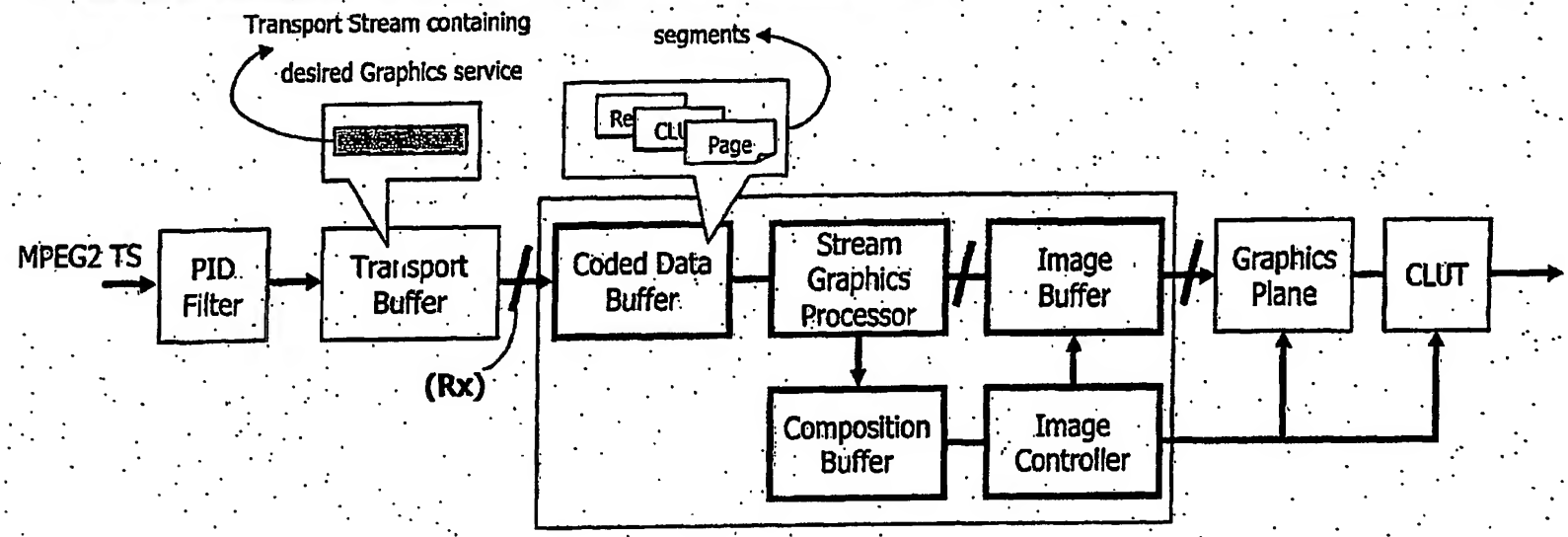
- Differences from DVB:
  1. Each PES Packet carries at most one segment i.e. does not transport multiple segments.
  2. An Object Data Segment can be carried over multiple PES packets.

Decoder Model Overview: Step-1



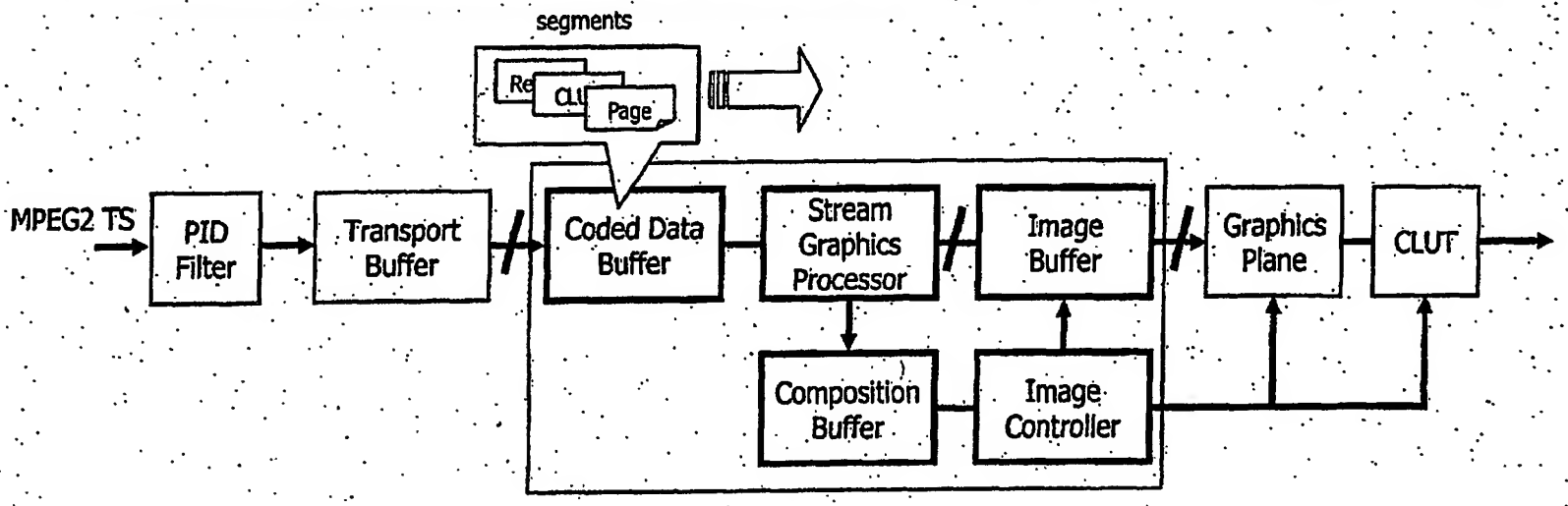
- **STEP 1 (NO issues):**
  - PID Filter selects the Transport Stream containing the desired Graphics Service and passes Transport packets from that Transport Stream onto the Transport Buffer.
  - No buffering or delay occurs inside the PID Filter, so Transport packets entering the PID Filter leave **instantaneously.**

Decoder Model Overview: Step-2



- **STEP 2 (NO issues):**
  - Transport packet headers and PES packet headers are removed and Segments are passed onto the Coded Data Buffer. Segments arrive in sequential order.
  - Data is removed from TB at the TB leak rate, Rx.
  - PTS/DTS values of PES packets are passed onto the decoder also.
  - Buffering in the TB, removal of transport packet data etc. is the same as defined in the MPEG (ISO/IEC13818-1) standard.

Decoder Model Overview: Step-3

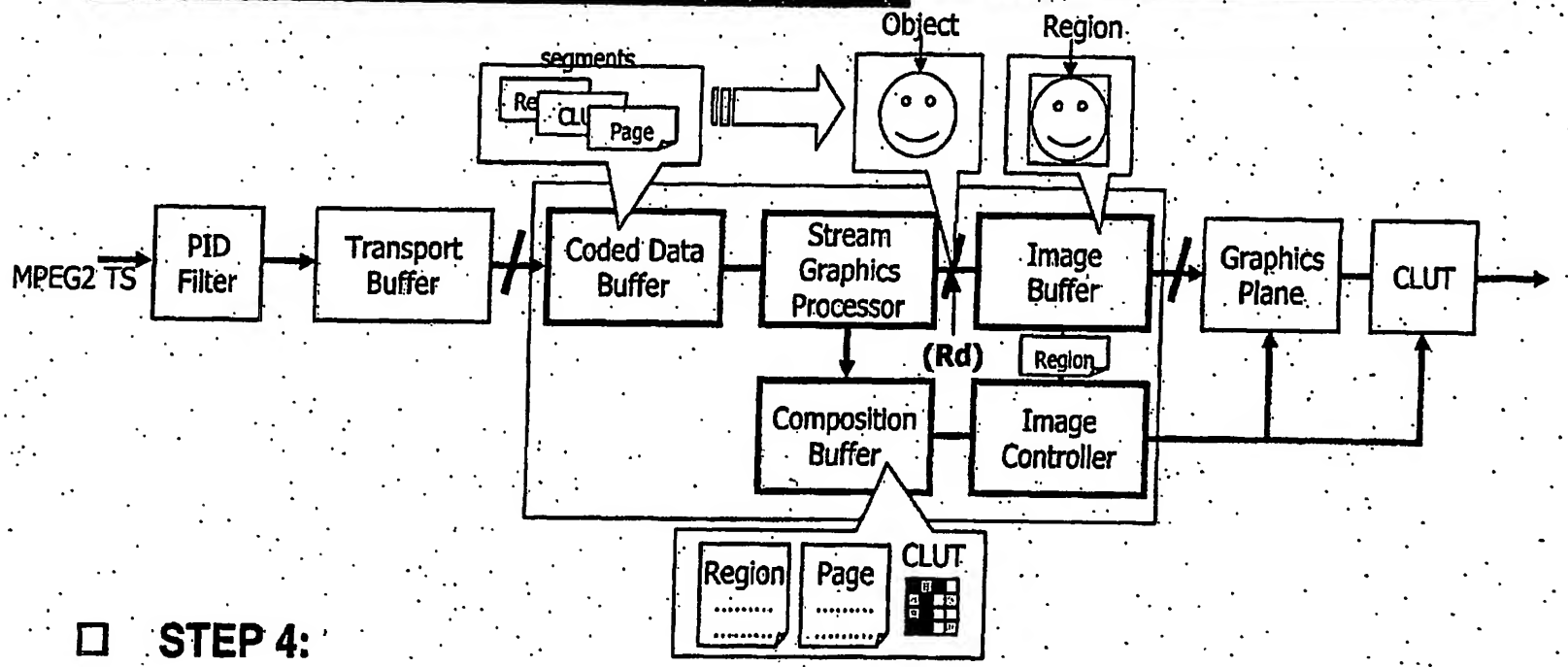


- **STEP 3:**
  - **Complete segments are instantaneously removed** from the Coded Data Buffer and instantaneously enter the Stream Graphics Processor as soon as **the DTS becomes valid.**
  - **All segments..sharing the same DTS and PTS constitute a Display Set.**

Decoder Model Overview: Step-3 Issues

- **"All segments..sharing the same DTS and PTS constitute a Display Set".**
  - We must carefully consider and clearly define the purpose of DTS and PTS in relation to the decoder model for each segment type (discussed later).
  - NOTE: DVB-SUB does not use DTS. We are significantly changing the decoding model here.

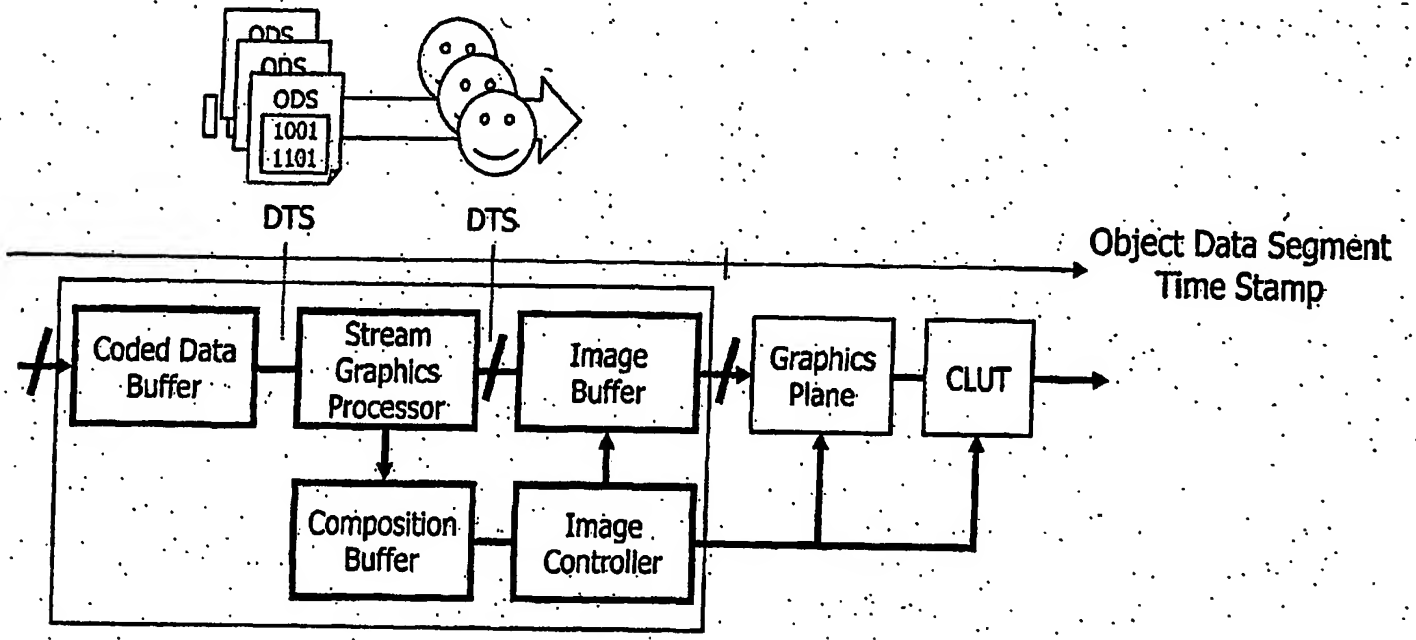
Decoder Model Overview: Step-4



- **STEP 4:**
  - The Stream Graphics Processor **decodes all the Object Segments belonging to the same Display Set** and **simultaneously transfers the decoded pixels into the Image Buffer.**
  - **Starting with the DTS associated with the display set and finishing after all pixels have been decoded,** the simultaneous transfer into DB is performed with the pixel decoding rate Rd.
  - The Stream Graphics Processor **transfers all other segments instantaneously** into the Composition Buffer.

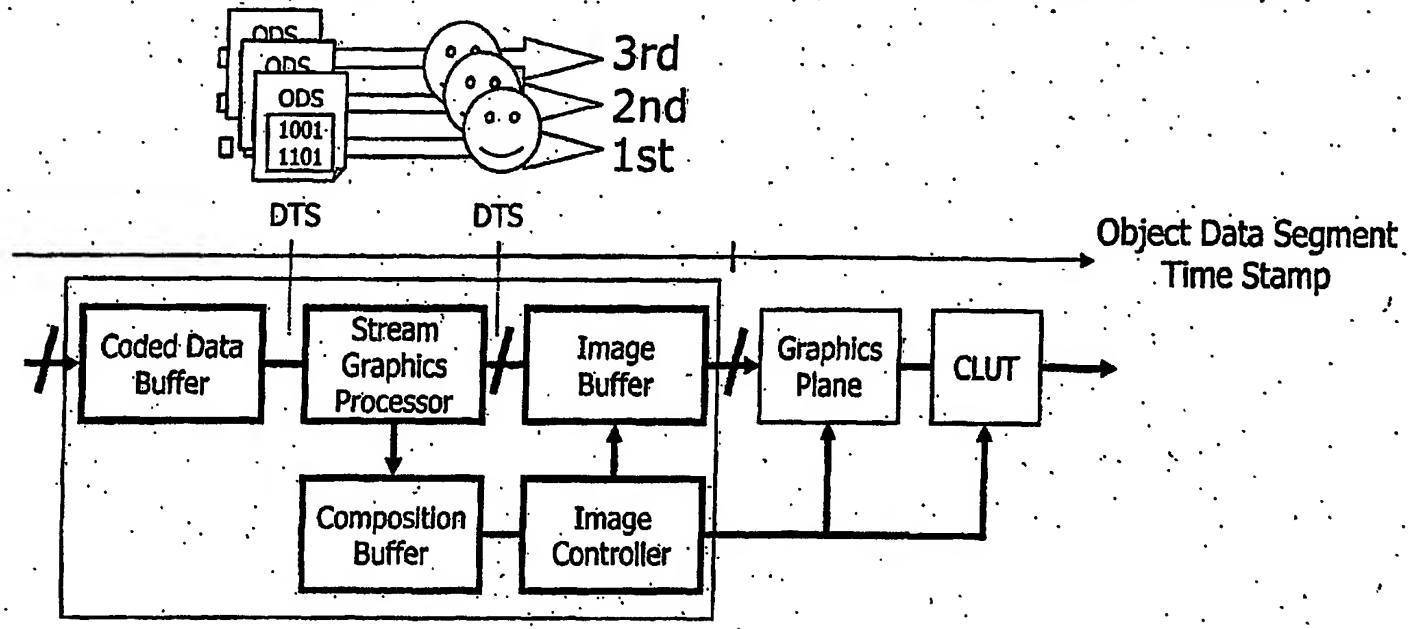
Decoder Model Overview: Step-4 Issues (1/2)

- **What is the model for the Stream Graphics Processor?**
  1. Is it an ideal model i.e. it **instantaneously decodes all Object pixels from ALL ODS AT ONCE** and simultaneously starts transfer to the Image Buffer?



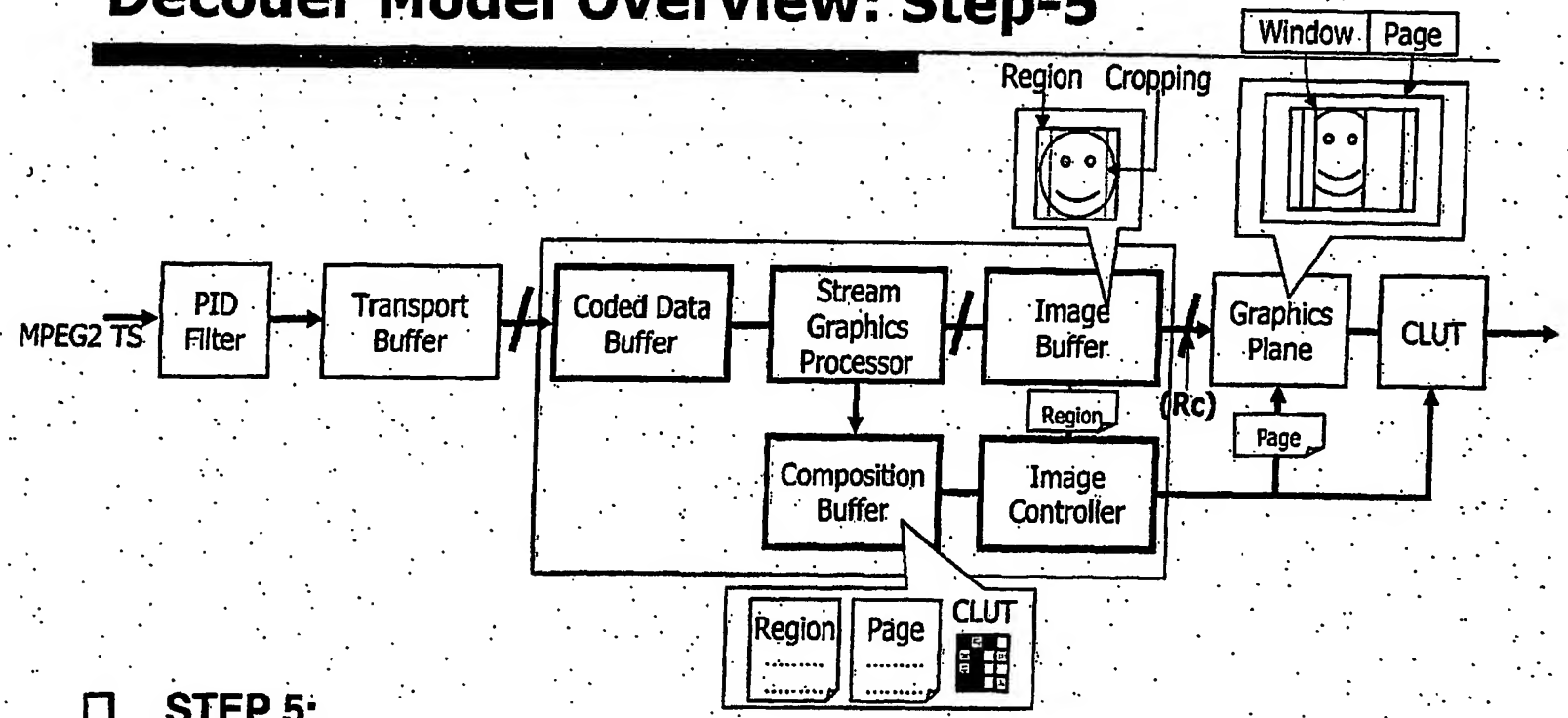
Decoder Model Overview: Step-4 Issues (2/2)

- **What is the model for the Stream Graphics Processor?**
  2. Is it an non-ideal model i.e. it **ONE-AT-A-TIME instantaneously decodes all Object pixels from EACH ODS** and simultaneously transfers to the Image Buffer (stops removing segments until all pixels have been transferred).



- NOTE: (2) is same as DVB-SUB model.

Decoder Model Overview: Step-5



- **STEP 5:**
  - Page Composition Segments describe the layout on the Graphics Plane.
  - **Page Composition segments shall only reference Regions** containing Objects that have been fully decoded i.e. **after PTS of Display Set containing Object.**
  - **Pixel data transfer from the Image Buffer** to the Graphics Plane **starts at DTS of Display Set.** Data is transferred at a Rate of Rc.
  - Transfer of data to Graphics Plane is **completed at PTS of Display Set.**

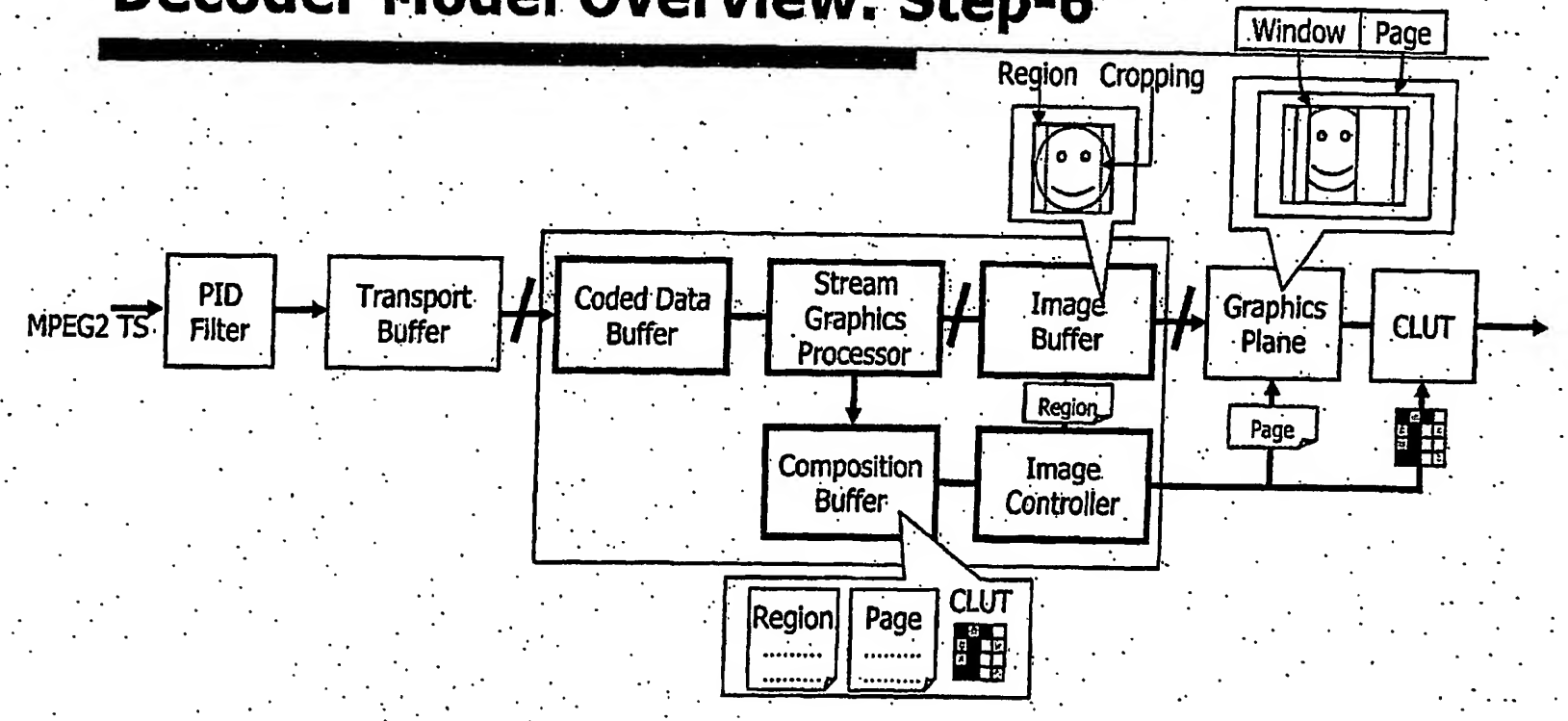
Decoder Model Overview: Step-5 Issues (1/2)

- **PCS/MCS cannot use Objects in the same Display Set:**
  - **Page Composition segments shall only reference Regions** containing Objects that have been fully decoded i.e. **AFTER the PTS of the Display Set containing the ODS.**
  - All **Segments must have the same PTS/DTS** values (see Step-3).
- **In this case, what is the meaning of Display Set?**
  - In DVB – each Display Set leads to a new Page Instance.
  - At start of Epoch, how do we handle?
    1. Have a PCS/MCS that does not reference any Regions i.e. blank Page?
    2. Have a PCS/MCS that reference Regions that do not reference any Objects i.e. blank Region?
    - What does this mean for display – a blank screen?
  - At an Acquisition Point, how do we handle? It is the same situation as at the start of an Epoch.
  - Do we need two Display Sets for every Object update? (one to transmit the Object, the other to Display it).

Decoder Model Overview: Step-5 Issues (2/2)

- **We must carefully consider and clearly define the purpose of DTS and PTS in relation to the decoder model for each segment type:**
  - In Step-5, DTS is defined to be the time when Pixel data transfer from the Image Buffer to the Graphics Plane starts.
  - In Step-3, DTS is defined to be the time when complete segments are instantaneously removed from the Coded Data Buffer and instantaneously enter the Stream Graphics Processor.

Decoder Model Overview: Step-6



- **STEP 6:**
  - CLUT data is transferred to CLUT on PTS of Display Set.

MEI Position

1. MEI think we need a clear definition of PTS/DTS.
2. MEI think that the Graphics Stream Processor should be non-ideal model.
3. MEI think PCS must be able to reference Objects in the same Display Set - Display Set should always lead to new Display Update.

MEI Proposal (1/2)

- **PCS/MCS:**
  - DTS: Decoding time of PCS/MCS (Decode trigger for Display Set) i.e. instantaneously transfer PCS/MCS from Coded Data Buffer to Composition Buffer.
  - PTS: Presentation time of Page Instance described in PCS/MCS i.e. all Region Content described in PCS/MCS is available on the Graphics Plane.
- **RCS:**
  - DTS: Decoding time of RCS i.e. instantaneously transfer RCS from Coded Data Buffer to Composition Buffer.
  - PTS: If RCS is referenced by PCS/MCS - start time of transfer of cropped Region content (described in PCS/MCS) from Image Buffer to Graphics Plane. If RCS is not referenced by PCS/MCS, PTS is same as DTS.
- **CLUT:**
  - DTS: Decoding time of CLUT i.e. instantaneously transfer CLUT from Coded Data Buffer to Composition Buffer.
  - PTS: Presentation time of Page Instance i.e. CLUT data is available in CLUT unit.
- **ODS:**
  - DTS: Decoding time of ODS i.e. instantaneously transfer ODS data to Stream Graphics process and simultaneously start transfer to Image Buffer.
  - PTS: Presentation time of ODS i.e. time Object is available in Image Buffer.

MEI Proposal (2/2)

- **Additional constraints on DVB-SUB for BD-ROM Graphics stream grammar:**
  - PCS/MCS must be present in every Display Set.
  - RCS must always be present for every region used in PCS/MCS.
  - ODS must appear in same order as order of reference from RCS in Display Set.
  - Order of RCS must be same as order of reference in PCS/MCS.
  - Order of RCS reference in PCS/MCS must be top-bottom/left-right.
  - If RCS is not referenced by PCS, must appear last in RCS set.
- **With the MEI DTS/PTS proposal it is possible to have a non-Pipelined or Pipelined decoder model:**
  - In a non-Pipelined decoder model, ALL Region Content must be available in the Image Buffer before transfer begins between the Image Buffer and Graphics Plane.
  - In a Pipelined decoder model, transfer can occur as soon as Region Content is available on the Graphics Plane.

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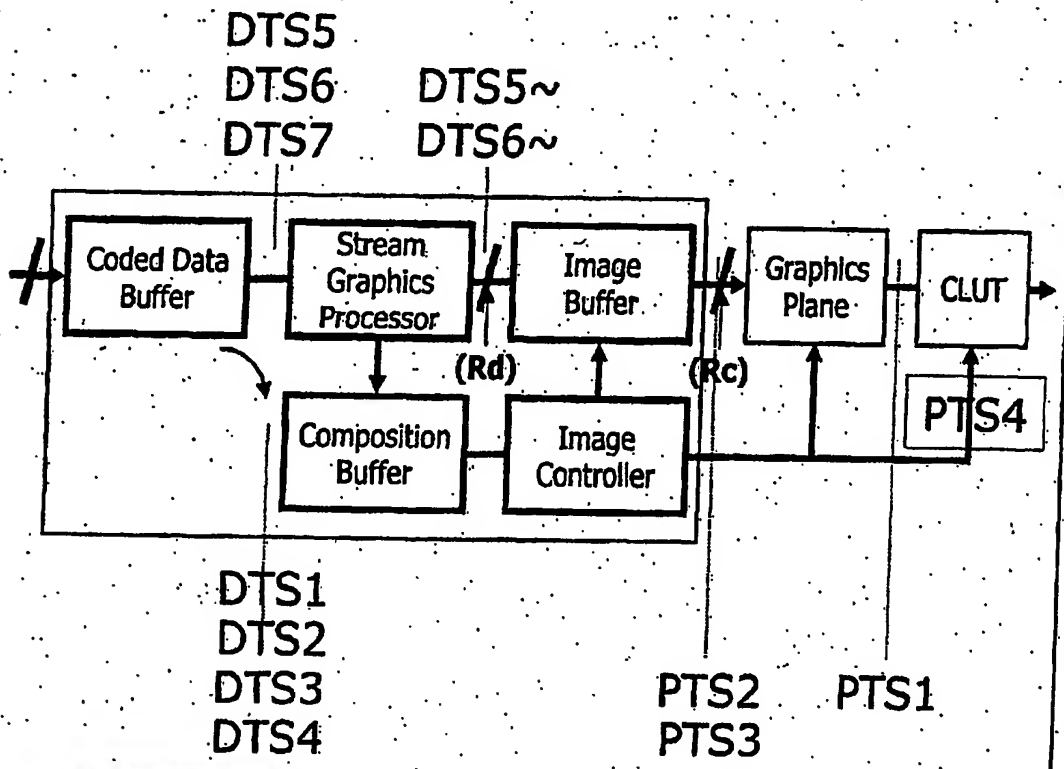
MEI Proposal: Non-pipelined Example 1

DTS1 DTS2 DTS3 DTS4 DTS5 DTS6 DTS7

PCS	RCS1	RCS2	CLUT	ODS1	ODS2	END

PTS1 PTS2 PTS3 PTS4 PTS5 PTS6 PTS7



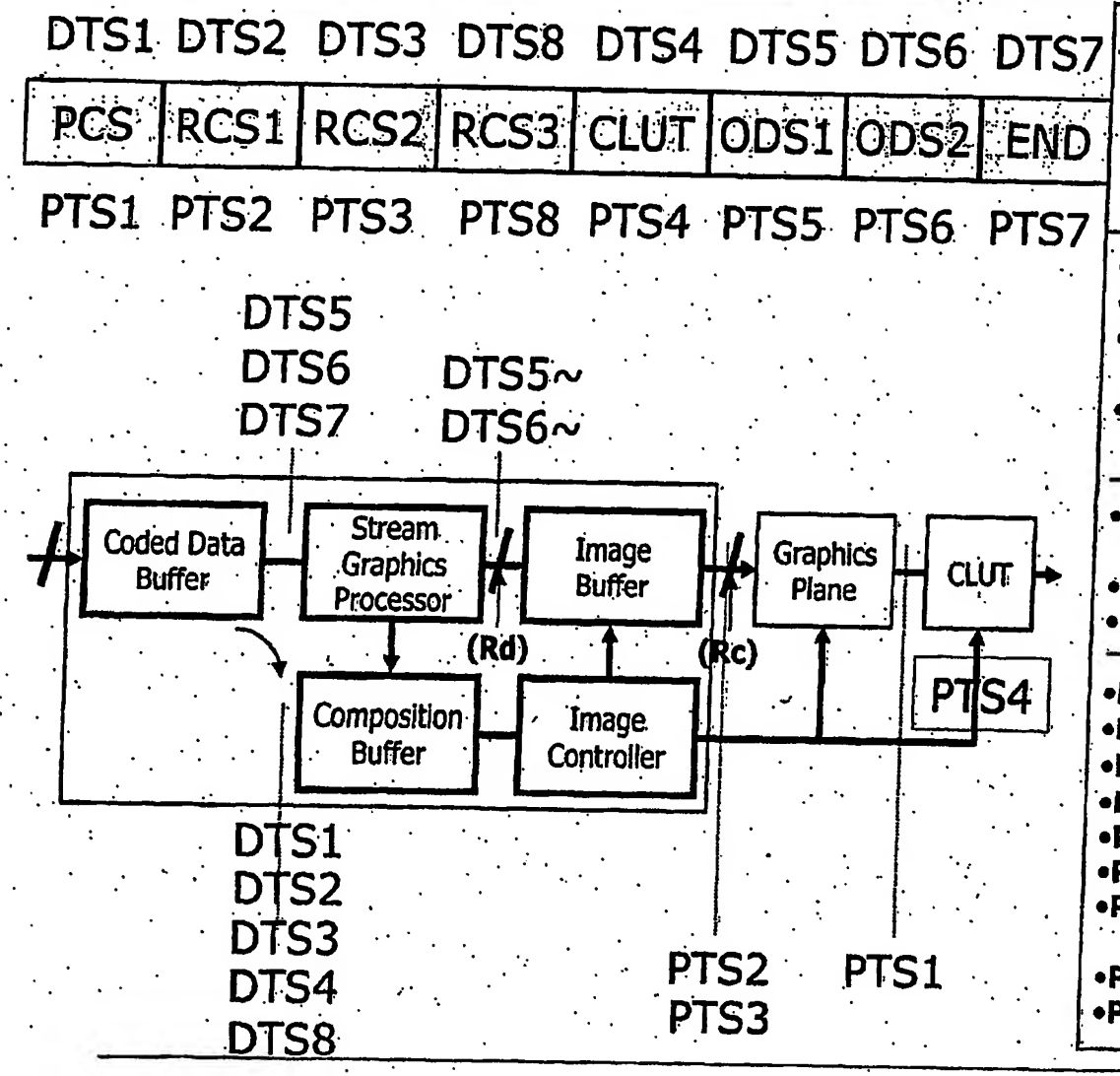
PCS references RCS1&2
RCS1 references ODS1
RCS2 references ODS2

- **OBJ1=decoded Object in ODS1.**
- **OBJ2=decoded Object in ODS2.**
- **R1=cropped Region Content described in RCS1.**
- **R2=cropped Region Content described in RCS2.**

- **DTS1=DTS2=DTS3=DTS4=DTS5**
- **DTS6=DTS5+(sizeOfOBJ1/Rd)**
- **DTS7=DTS6+(sizeOfOBJ2/Rd)**

- **PTS5=DTS5+(sizeOfOBJ1/Rd)**
- **PTS6=DTS6+(sizeOfOBJ2/Rd)**
- **PTS2=PTS6**
- **PTS3=PTS2+(sizeOfR1/Rc)**
- **PTS7=DTS7**
- **PTS1>=PTS3+(sizeOfR2/Rc)**
- **PTS1<PTS3+(sizeOfR2/Rc)+ 1 frame period.**
- **PTS4=PTS1**

MEI Proposal: Non-pipelined Example 2



PCS references RCS1&2
RCS1 references ODS1
RCS2 references ODS2
RCS3 has no ODS ref.

- **OBJ1=decoded Object in ODS1.**
- **OBJ2=decoded Object in ODS2.**
- **R1=cropped Region Content described in RCS1.**
- **R2=cropped Region Content described in RCS2.**

- **DTS1=DTS2=DTS3=DTS4=DTS5=DTS8**
- **DTS6=DTS5+(sizeOfOBJ1/Rd)**
- **DTS7=DTS6+(sizeOfOBJ2/Rd)**

- **PTS5=DTS5+(sizeOfOBJ1/Rd)**
- **PTS6=DTS6+(sizeOfOBJ2/Rd)**
- **PTS2=PTS6**
- **PTS3=PTS2+(sizeOfR1/Rc)**
- **PTS7=DTS7**
- **PTS1>=PTS3+(sizeOfR2/Rc)**
- **PTS1<PTS3+(sizeOfR2/Rc)+** 1 frame period.
- **PTS4=PTS1**
- **PTS8=PTS1**

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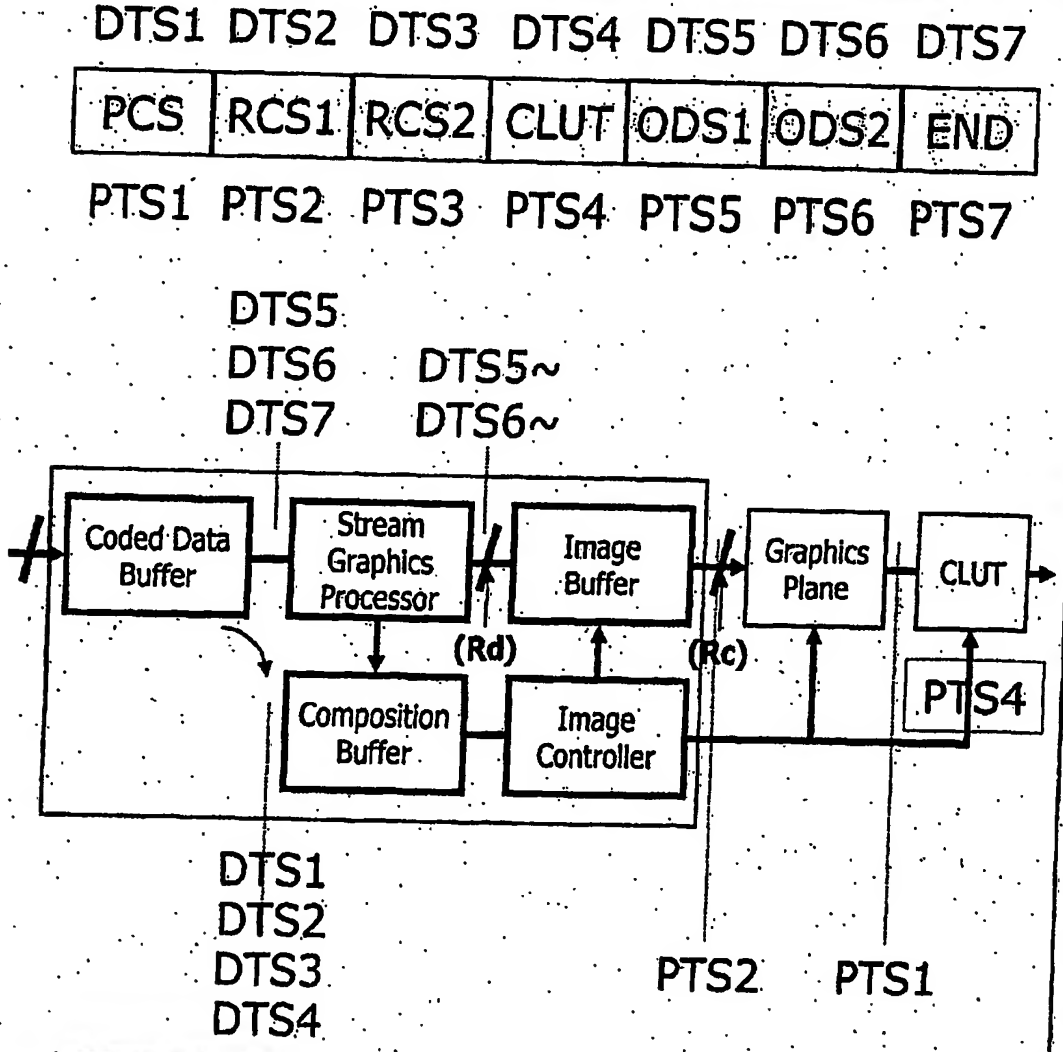
MEI Proposal: Non-pipelined Example 3



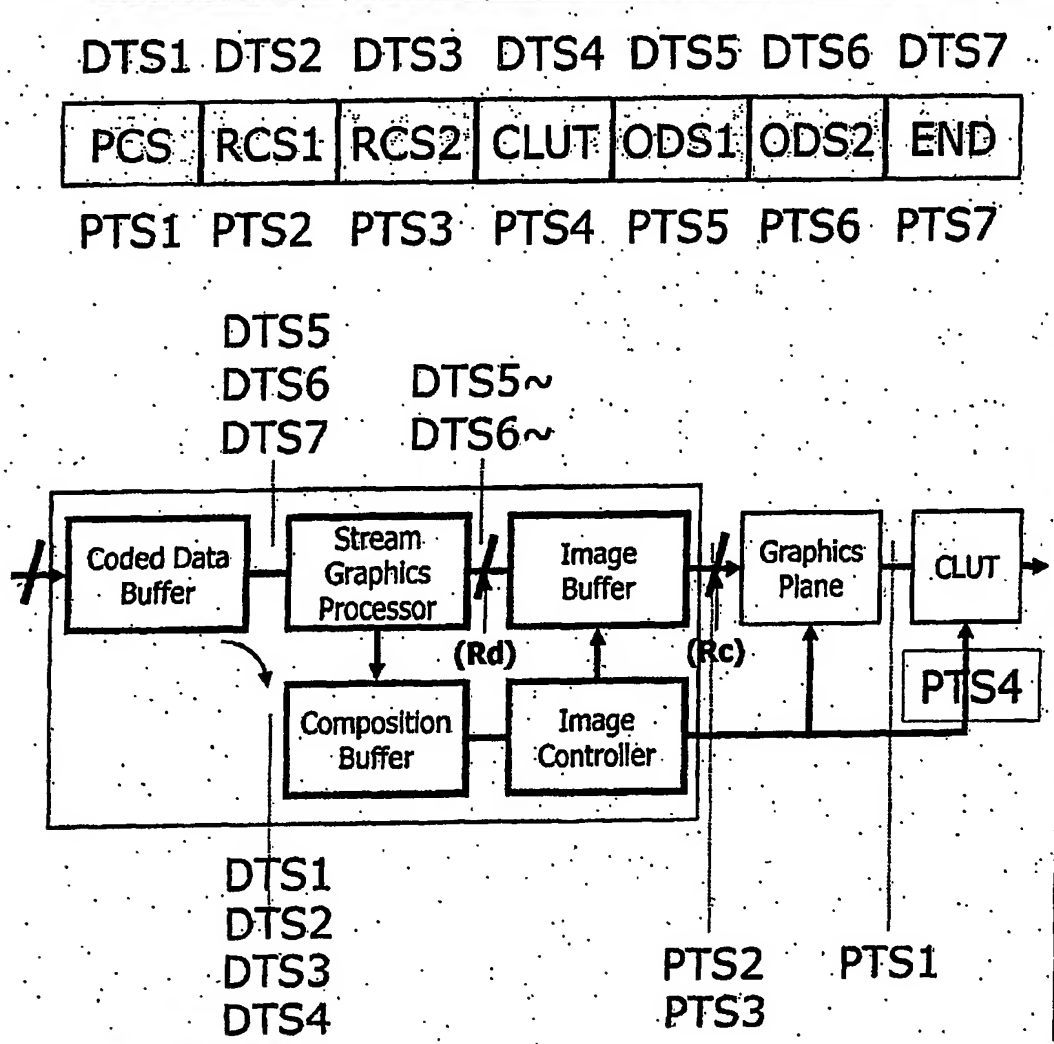
PCS references RCS1 only
RCS1 references ODS1
RCS2 references ODS2

- **OBJ1=decoded Object in ODS1.**
- **OBJ2=decoded Object in ODS2.**
- **R1=cropped Region Content described in RCS1.**
- **R2=cropped Region Content described in RCS2.**

- **DTS1=DTS2=DTS3=DTS4=DTS5**
- **DTS6=DTS5+(sizeOfOBJ1/Rd)**
- **DTS7=DTS6+(sizeOfOBJ2/Rd)**

- **PTS3=DTS3**
- **PTS5=DTS5+(sizeOfOBJ1/Rd)**
- **PTS6=DTS6+(sizeOfOBJ2/Rd)**
- **PTS2=PTS6**
- **PTS7=DTS7**
- **PTS1>=PTS2+(sizeOfR1/Rc)**
- **PTS1<PTS2+(sizeOfR1/Rc)+** 1 frame period.
- **PTS4=PTS1**

MEI Proposal: Pipelined Example 1



PCS references RCS1&2
RCS1 references ODS1
RCS2 references ODS2

- **OBJ1=decoded Object in ODS1.**
- **OBJ2=decoded Object in ODS2.**
- **R1=cropped Region Content described in RCS1.**
- **R2=cropped Region Content described in RCS2.**

- **DTS1=DTS2=DTS3=DTS4=DTS5**
- **DTS6=DTS5+(sizeOfOBJ1/Rd)**
- **DTS7=DTS6+(sizeOfOBJ2/Rd)**

- **PTS5=DTS5+(sizeOfOBJ1/Rd)**
- **PTS6=DTS6+(sizeOfOBJ2/Rd)**
- **PTS2=PTS5**
- **PTS3=PTS6** (if Rc>=Rd)
- **PTS3>PTS6** (if Rc>=Rd)
- **PTS7=DTS7**
- **PTS1>=PTS3+(sizeOfR2/Rc)**
- **PTS1<PTS3+(sizeOfR2/Rc)+** 1 frame period.
- **PTS4=PTS1**

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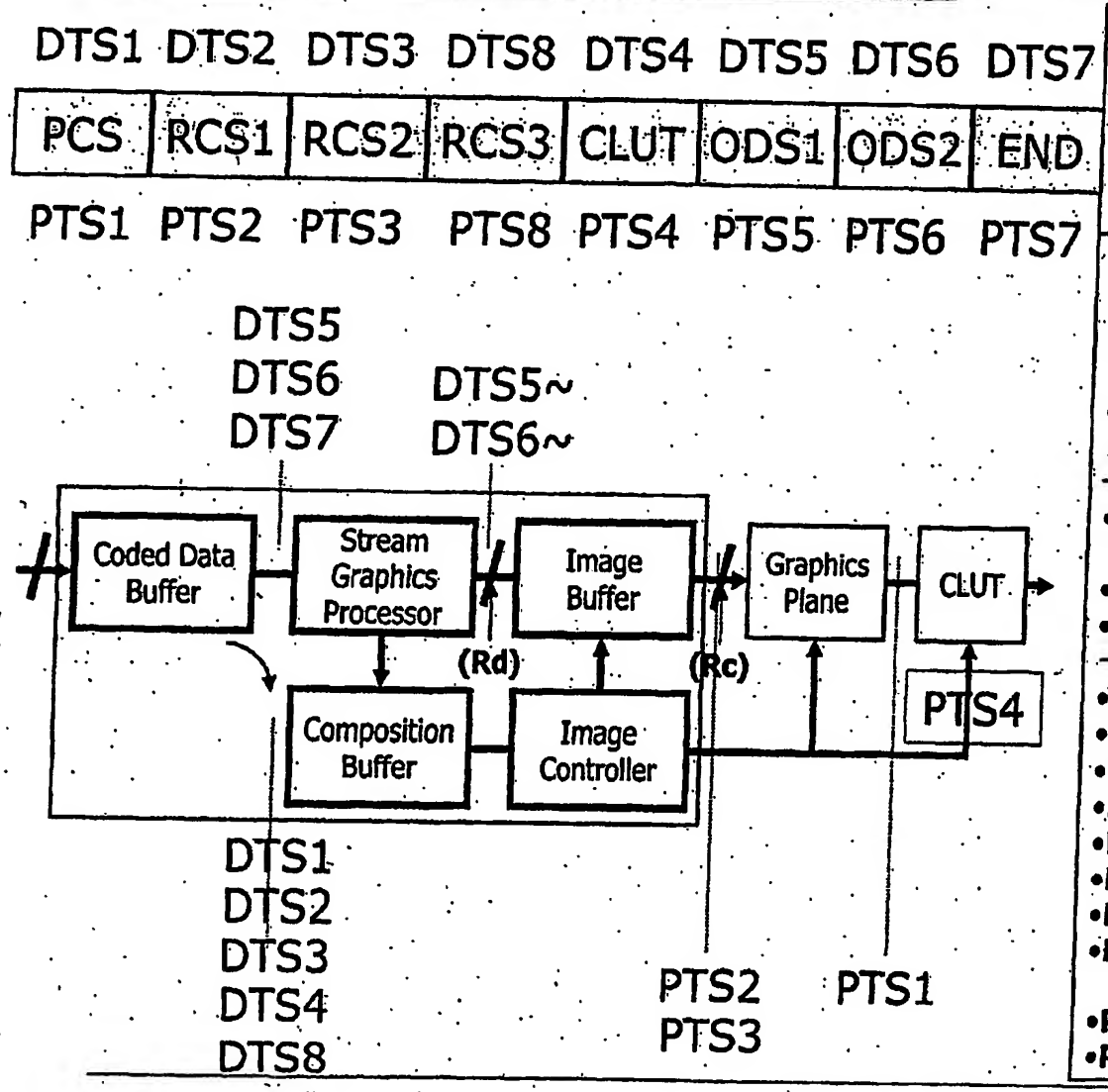
MEI Proposal: Pipelined Example 2



PCS references RCS1&2
RCS1 references ODS1
RCS2 references ODS2
RCS3 has no ODS ref.

- **OBJ1=decoded Object in ODS1.**
- **OBJ2=decoded Object in ODS2.**
- **R1=cropped Region Content described in RCS1.**
- **R2=cropped Region Content described in RCS2.**

- **DTS1=DTS2=DTS3=DTS4=DTS5=DTS8**
- **DTS6=DTS5+(sizeOfOBJ1/Rd)**
- **DTS7=DTS6+(sizeOfOBJ2/Rd)**

- **PTS5=DTS5+(sizeOfOBJ1/Rd)**
- **PTS6=DTS6+(sizeOfOBJ2/Rd)**
- **PTS2=PTS5**
- **PTS3=PTS6** (If Rc>=Rd)
- **PTS3>PTS6** (If Rc>=Rd)
- **PTS7=DTS7**
- **PTS1>=PTS3+(sizeOfR2/Rc)**
- **PTS1<PTS3+(sizeOfR2/Rc)+** 1 frame period.
- **PTS4=PTS1**
- **PTS8=PTS1**

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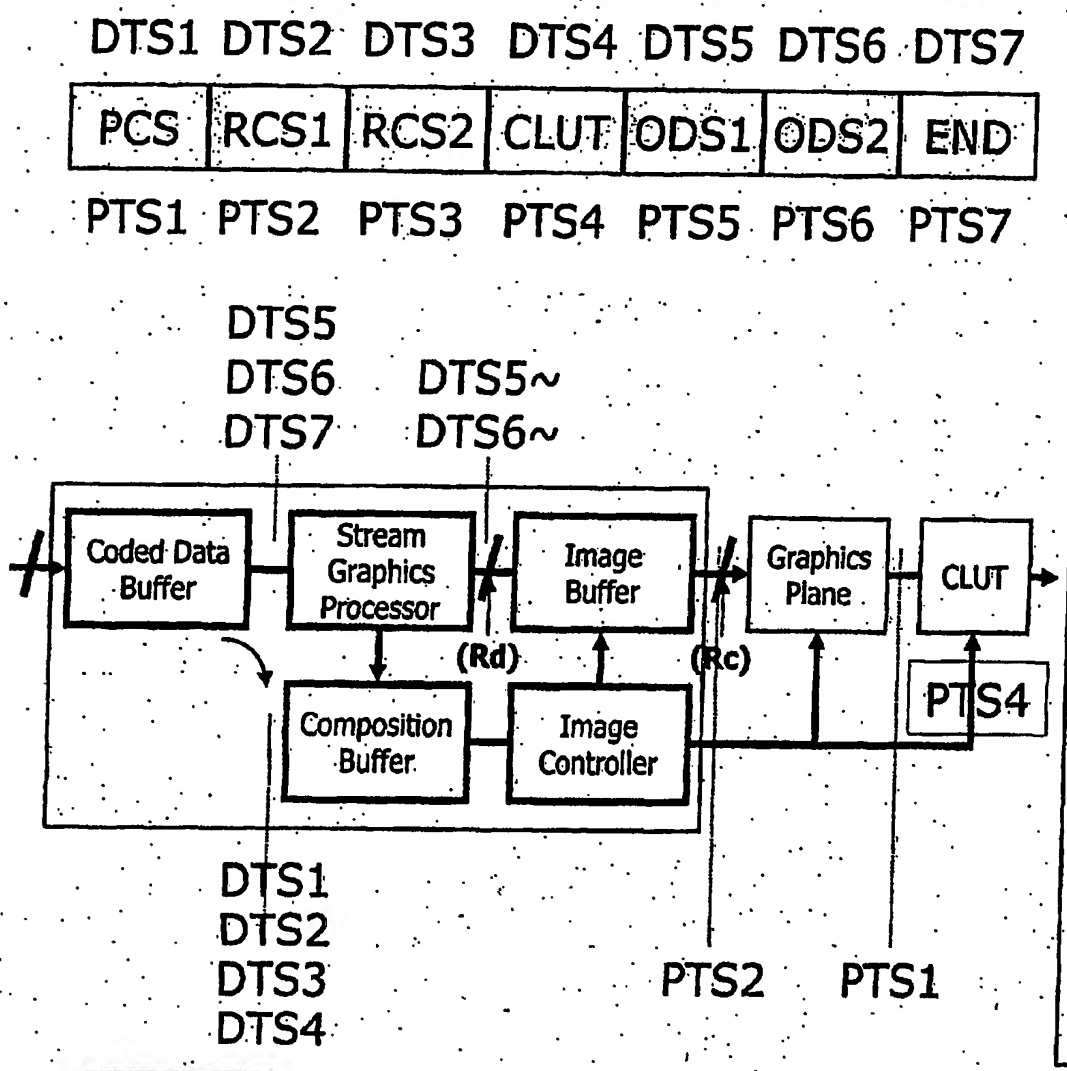
MEI Proposal: Non-pipelined Example 3



PCS references RCS1 only
RCS1 references ODS1
RCS2 references ODS2

- **OBJ1=decoded Object in ODS1.**
- **OBJ2=decoded Object in ODS2.**
- **R1=cropped Region Content described in RCS1.**
- **R2=cropped Region Content described in RCS2.**

- **DTS1=DTS2=DTS3=DTS4=DTS5**
- **DTS6=DTS5+(sizeOfOBJ1/Rd)**
- **DTS7=DTS6+(sizeOfOBJ2/Rd)**

- **PTS3=DTS3**
- **PTS5=DTS5+(sizeOfOBJ1/Rd)**
- **PTS6=DTS6+(sizeOfOBJ2/Rd)**
- **PTS2=PTS5**
- **PTS7=DTS7**
- **PTS1>=PTS2+(sizeOfR1/Rc)**
- **PTS1<PTS2+(sizeOfR1/Rc)+** 1 frame period.
- **PTS4=PTS1**